

741 d

PROCEEDINGS
OF THE
ROYAL SOCIETY OF EDINBURGH.

1841-1842.

No. 19.*

Monday, 6th December 1841.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following communications were read :—

1. On the Circulation of the Blood, and the Difference of the Laws of Fluids moving in Living and Dead Tubes. Part Second. By Sir Charles Bell.

He recommenced with the statement of the difference with which water flowed from a reservoir through tubes of equal calibre, but unequal lengths; and of the effect of pressure on elastic tubes, shewing that the impediment to the transmission of fluid through them was proportioned to their length. He stated that the obstruction at the turn of a tube, was proportioned to the acuteness of the angle. He then inferred that the arteries were in circumstances to render the delivery of blood unequal, unless there was a living property additional to the hydraulic laws.

Then, referring to the effect of capillary attraction, he argued, that if the law prevailed in the animal body as in dead tubes, then, on estimating the length of vessels of capillary size, and the attraction existing between solid and fluid, the circulation could not go on.

He then stated the surprising living qualities in the animal sur-

42. 6. 14. 222.

faces, of repelling, attracting, selecting; hence inferring, that in the surface of the arteries, there did not prevail that attraction which caused the capillary phenomena in dead tubes.

Proceeding to illustrate his position by the phenomena exhibited by the microscope, and by the occurrences familiar to the surgeon during operation, he concluded that the inner surface of the bloodvessels had an influence on the blood contained, of preserving it fluid, and of resisting attraction: But that, when the vitality of their coats was diminished or disturbed, as by the violent tearing of the artery; then coagulation of the blood, and attraction of the blood to the sides of the artery, took place, by which the hæmorrhage was stopped.

2. On a Peculiar Structure observed by the Author in the Ice of Glaciers. By Professor Forbes.

This structure, which appears to have escaped the notice of authors on the subject, is a veined or ribboned appearance which pervades the whole ice of many glaciers. The veins or bands are occasioned by the alternation of ice more or less compact; that which is porous approaching to white or whitish green, the denser ice having a bluish tint. The thickness varies from a fraction of an inch to several inches, and the parallelism may be considered as complete through considerable spaces. It extends in more or less complete development from the *névé*, or uncompacted glacier, down to the inferior termination; and during the greater part of this space, in the case of the lower glacier of the Aar, the bands were parallel to the lofty walls by which the glacier was bounded laterally; their position was generally vertical, but sloping from below upwards and outwards as the distance from the sides of the glacier diminished. Towards the lower end of the glacier the structure became very obscure, and for a time nearly vanished. It appears, however, that these bands or veins change their direction from longitudinal to transverse, their outcropping being parallel to the end of the glacier, the apparent strata there dipping inwards at an angle of 10° or 20° . It is this appearance which has given rise to the mistaken idea of horizontal stratification in glaciers. The veined structure rises towards the sides or supporting walls, and has altogether the appearance of being determined by the contour of the ice, and perhaps by the lines of greatest pressure in its interior. In the case of the lower part of the glacier of the Rhone, the veined structure forms conical sur-

faces, widening upwards, and more and more obtuse as we recede from the centre of pressure, from which the descending glacier is spread out in all directions; its extension producing fissures which extend like radii, and which appear to be always perpendicular to the direction of the structural planes.

Without attempting to explain the process by which so peculiar and interesting a phenomenon is produced, the author remarks, that its existence and production is highly important in two points of view:—(1.) As defining in some respects the nature of icy structure in glaciers, which has been so keenly contested by later writers, and on which so much of the theory of the progression of glaciers depends; and, (2.) As illustrating by analogy the mysterious geological phenomena of cleavage planes, which have been attempted to be accounted for by the presence and energy of polar and crystalline forces, without any evidence having been adduced how such a structure could result from them. The structure of a glacier is daily forming; its analysis falls within the proper domain of physical inquiry; and however hopeless direct experiments in the laboratory must be on such a subject, the required evidence may be perhaps attained by the careful study of glacier crystallization.

James Kinnear, Esq., recommended by Dr Borthwick, was duly elected an Ordinary Fellow.

The following Donations were reported as having been received since the close of last Session:—

Astronomical Observations made at the Royal Observatory, Greenwich, in the years 1838 and 1839, under the direction of George Riddell Airy, Esq. 2 Vols.—*By the Royal Society of London.*

Journal of the Royal Geographical Society of London. Vol. x. Part 3.—*By the Society.*

Report of the Tenth Meeting of the British Association for the Advancement of Science, held at Glasgow in August 1840.—*By the British Association.*

Bulletin de la Société Géologique de France. Tome x. Feuilles 24–29. Tome xi. et Tome xii. Feuilles 1–11.—*By the Society.*

Proceedings of the Meteorological Society during the Sessions 1838–39 and 1839–40.—*By the Society.*

Quarterly Journal of the Statistical Society. Vol. iv. Part 1–2.—*By the Society.*

- Proceedings of the American Philosophical Society. Nos. 14', 15, 16, 17, 18.—*By the Society.*
- Transactions of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. New Series. Vol. vii. Parts 2, 3.—*By the Society.*
- Flora Batava. No. 122.—*By the King of Holland.*
- Produzioni relative al Programma di tre quistioni Geometriche proposto da un nostro professore.—*By the Author.*
- Problema Fondamentale per le polari Coniche Reciproche Geometricamente Risolto da Nicola Trudi.—*By the Author.*
- Boston Journal of Natural History, containing Papers and Communications read to the Boston Society of Natural History, and published by their direction. Vols. i. ii. and vol. iii., Parts 1, 2, 3.—*By the Boston Society of Natural History.*
- The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. Nos. 53, 54, and 55.—*By the Highland and Agricultural Society.*
- The American Journal of Science and Arts, conducted by Professor Silliman and Benjamin Silliman jun. For April, July, and October 1841.—*By the Editors.*
- Lectures on Agricultural Chemistry and Geology. By James F. W. Johnston. Nos. 1 to 11.—*By the Author.*
- Mémoire sur la Chaleur Solaire, sur les pouvoirs Rayonnants et Absorbants de l'air atmospherique, et sur la temperature de l'Espace. Par M. Pouillet.—*By the Author.*
- Bulletin de la Société d'Encouragement pour l'Industrie Nationale pour 1840.—*By the Society.*
- The Article on the Silurian System, from the Edinburgh Review for April 1841. By W. H. Fitton, Esq.—*By the Author.*
- Catalogue de l'Ecole des Vignes de la Pepiniere du Luxembourg.—*Par le Duc Decaze.*
- Commentatio de usu Experientiarum Metallurgicarum ad disquisitiones Geologicas adjuvandas. Auctore J. F. L. Hausmann.—*By the Author.*
- Illustrations of the Affinity of the Latin Language to the Gaelic or Celtic of Scotland. By T. Stratton, Esq.—*By the Author.*
- Madras Journal of Literature and Science. April to September 1840.—*By the Madras Literary Society.*
- Mémoires de la Société Geologique de France. Tome iii. and Tome iv. premiere partie.—*By the Society.*

Proceedings of the London Electrical Society. Session 1841-42.
Nos. 1, 2.

The Transactions and the Proceedings of the London Electrical
Society. Vol. i.—*By the Society.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitge-
geven door J. Van Der Hoeven, M.D., en W. H. De Vriese,
M.D. Deel viii. St. 2, 3.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des
Sciences. Tome xii. Nos. 25, 26, et Tome xiii. Nos. 1-18.
—*By the Academy.*

Traité Élémentaire des Fonctions Elliptiques. Par P. F. Ver-
hulst.—*By the Author.*

Analyse Raisonnée des Travaux de Georges Cuvier, Précédée de
son Elogé. Par P. Flourens.—*By the Author.*

Des moyens de soustraire l'Exploitation des Mines de Houille
aux chances d'explosion. Recueil de Memoires et de Rap-
ports publié par l'Académie Royale des Sciences et Belles
Lettres de Bruxelles.

Annuaire de l'Observatoire Royal de Bruxelles, pour l'an 1841.
Par le Directeur, A. Quetelet.

Annuaire de l'Académie Royale des Sciences et Belles Lettres de
Bruxelles. 1841.

Bulletin de l'Académie Royale de Bruxelles. Tome vii. Nos. 9,
10, 11, 12. Tome viii. Nos. 1-6.

Nouveaux Memoires de l'Académie Royale des Sciences et Belles
Lettres de Bruxelles. Tome xiii.

Memoires Couronnés par l'Académie Royale des Sciences et Belles
Lettres de Bruxelles. Tome xiv.—*By the Academy.*

Annuaire Magnetique et Meteorologique du Corps des Ingenieurs
des Mines de Russie pour l'année 1839. Par A. T. Kupffer.
—*By the Author.*

The Eighth Annual Report of the Royal Cornwall Polytechnic So-
ciety. 1840.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 105, 106, 107,
108, 109, 110, 111.—*By the Society.*

Proceedings of the Geological Society of London. No. 76.

Transactions of the Geological Society of London. New Series.
Vol. vi. Part 1.—*By the Society.*

Bulletin de la Société de Géographie. Deuxieme Serie. Tomes
13, 14, 15.—*By the Society.*

Recueil de Voyages et de Memoires publié par la Société de Géo-
graphie. Tome vi.—*By the Society.*

Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem. (Second Series.) Deel i.—*By the Society.*

The Oily Acids, forming the first Supplement to the Seventh Edition of Dr Turner's Chemistry. By Justus Liebig, M.D., and William Gregory, M.D.—*By the Editors.*

Annuaire du Journal des Mines de Russie, pour les Années 1835, 36, 37, et 38, et Introduction. 5 Tomes.—*By General Tchefskine.*

Transactions of the Botanical Society of Edinburgh. Vol. i. Parts 1, 2.

Fourth and Fifth Annual Reports and Proceedings of the Botanical Society of Edinburgh.—*By the Society.*

Eighteenth Report of the Whitby Literary and Philosophical Society, presented at the Annual Meeting, November 4. 1840.—*By the Society.*

Dictionarium Anamitico-Latinum, primitus inceptum ab illustrissimo et Reverendissimo P. J. Pigneaux, Vicario Apostolico Cocincinæ, et dein absolutum et editum a J. L. Taberd, Episcopo Isauropolitano, &c.—*By the Editor.*

Dictionarium Latino-Anamiticum, auctore J. L. Taberd, Episcopo Isauropolitano, &c.—*By the Author.*

Abstract of the Magnetic Observations made at the Trevandrum Observatory, during the month of May 1841. By John Caldecott, Esq., Director.—*By the Author.*

Museo Numismatico Lavy appartenente alla R. Accademia delle Scienze di Torino. Parts 1, 2.—*By Chevalier P. Lavy.*

Descriptive Account of the Antiquities and Coins of Affghanistan. By H. H. Wilson.—*By the Honourable the Directors of the E. I. C.*

Archives de l' Electricité. Par N. A. de la Rive. No. 1.—*By the Author.*

Det Kengelige Danske Videnskabernes Selskabs Naturvidenskabelige og Mathematiske Afhandlinger. 8 Vols.—*By the Academy.*

An Abridgement of the Acts of the Parliament of Scotland from 1424 to 1707. By William Alexander, Esq., W.S., F.R.S.E.—*By the Author.*

Transactions of the Philosophical Society of Cambridge. Vol. vii. Part 2.—*By the Society.*

Annals of the Lyceum of Natural History of New York. Vols. i. ii. iii. iv. Parts 1, 2, 3, and 4.—*By the Directors of the Lyceum.*

- Voyage dans la Russie Méridionale et la Crimée. Par M. Anatole de Demidoff. Planches. Liv^{ns} 6, 7.—*By the Author.*
- Commentationes Societatis Regiæ Scientiarum Gottingensis Recentiores. Vols. 7 and 8.—*By the Society.*
- Reports presented to the Legislature of the Commonwealth of Massachusetts on Wheat and Silk, Invertebrate Animals, Herbaceous Plants and Quadrupeds.—*By the Bowditch Family.*
- Æsop's Fables, written in Chinese by the learned Mun Mooy Seen-Shang. Translated by Robert Thom, Esq.—*By the Translator.*
- Ancient Laws and Institutes of Wales.—*By the Commissioners on Public Records.*
- Novorum Actorum Academiae Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. 18. Supplement.—*By the Academy.*
- Monografia de genere Murex ossia enumerazione delle principali specie. Per Giov. Michelotti.—*By the Author.*
- List of the Instruments and Apparatus belonging to the Royal Society.
- List of the Portraits in possession of the Royal Society.
- Report of the Committee of Physics, including Meteorology, on the objects of Scientific Inquiry in those Sciences.
- Catalogue of the Scientific Books in the Library of the Royal Society.
- Catalogues of the Miscellaneous Manuscripts and of the Manuscript Letters in the possession of the Royal Society.
- Statutes of the Royal Society. 1840.
- Proceedings of the Royal Society of London. Nos. 46, 47, 48.
- Philosophical Transactions of the Royal Society of London for 1841. Part 1.
- Astronomical Observations made at the Royal Observatory, Edinburgh. Vol. 4. By Thomas Henderson, F. R. SS. L. & E., &c.—*By the Royal Society of London.*
- Rara Mathematica; or, a Collection of Treatises on the Mathematics and Subjects connected with them. Edited by J. O. Halliwell.—*By the Editor.*
- Mémoire sur differens Procédés d'Integration. Par J. Plana, à Turin.—*By the Author.*
- Abhandlungen der Königlischen Akademie der Wissenschaften zu Berlin. 1839.
- Bericht über die zur Bekanntmachung geeigneten Verhandlungen

der Konigl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1840 bis Juni 1841.—*By the Academy.*

The American Almanac and Repository of Useful Knowledge for 1841.—*By the Phil. Society of America.*

Proceedings of the Zoological Society. Oct. 13. 1840 to July 27. 1841.—*By the Society.*

Letter-Press to the First Part of the Natural History and Illustrations of the Scottish Salmonidæ. By Sir William Jardine, Bart.—*By the Author.*

Ordnance Survey of Ireland. County Galway.—*By His Excellency the Lord Lieutenant.*

Monday, 20th December.

Dr HOPE, V.P. in the Chair.

The following communications were read:—

1. Report of a Committee on the Papers of David Hume, bequeathed to the Society by the late Baron Hume. Communicated by the Council.

The Committee to whose examination the papers bequeathed to the Royal Society of Edinburgh by the late Baron Hume, has been intrusted, in the view of suggesting what might be the most proper and useful plan for their future disposal, consistently with the peculiar character and functions of the learned body to which they now belong, having proceeded to examine their contents with care, have now to offer, though not without considerable hesitation, the views that have occurred to them.

Independently of some valuable and interesting autographs of Mr David Hume, to be mentioned in the sequel, the important part of this bequest, to which the attention of the Committee has been more particularly directed, consists of a miscellaneous and very broken mass of letters, which may, in general, be described as the Private and Confidential Correspondence of that illustrious philosopher and historian. Of these letters, about one hundred and forty-five are written by Mr Hume; the number of those addressed to him is about five hundred and fifty; making a total of nearly seven hundred letters.

Mr Hume's epistolary correspondents appear to have been very numerous, especially in the later periods of his life, when his literary fame had been established, and he had become personally known in a

very extensive circle of acquaintance both at home and abroad ; among whom are to be found many persons of the most distinguished ranks in society, as well as of the highest eminence in science and learning. In many instances, indeed, the letters addressed to Mr Hume are little more than complimentary expressions of homage to an illustrious writer, and derive any interest they possess from the evidence they afford of the extensive diffusion of his fame as a philosopher and historian. But the greater and more valuable part of the collection consists of the correspondence of those with whom he lived on terms of intimate friendship, to whom he was in the habit of communicating his thoughts and feelings with a singular degree of openness and playful simplicity, and by whom he appears to have been beloved and caressed with a fondness of attachment that affords the most pleasing testimony to the truthfulness and amiability of his character in private life, and a striking contrast to the impressions that may have been received by those to whom Mr Hume is known only in his metaphysical and historical writings. The letters, in general, are not controversial or discursive ; there are occasionally introduced discussions on topics of permanent interest ; but even in his correspondence with those to whom his peculiar opinions were the most offensive, there prevails the same mutual kindness and forbearance with which he appears to have inspired his more intimate associates.

Such being the general character and description of the papers in question, it appears to your Committee that the value they possess is chiefly to be derived from the illustrations they might furnish of the literary history of Mr Hume. Whatever diversity of opinion may exist as to the tendency of his philosophical or political speculations, it must on all hands be admitted that he has attained, and must continue to occupy, a station in the literature of his country that cannot fail to make the formation of his character and the progress of his literary labours to be regarded as objects of more than ordinary interest. In that view, these papers may be justly esteemed of great value. The series is indeed very imperfect, and probably its defects cannot now be fully supplied from any other sources ; but enough is preserved to throw some curious and interesting lights on even the earliest period of Mr Hume's career ; and the materials may here be found for tracing his subsequent progress through life with the most minute accuracy.

In what manner these materials ought now to be employed, is a question which, to your Committee, appears to be of considerable difficulty. In the terms of Baron Hume's bequest, no particular

object or definite purpose is expressed ; nor, in the ultimate disposal of these papers, has the Society been fettered by any limitations or conditions. His motives, however, in selecting the Society as the depositary of these remains of his illustrious kinsman, must have been at once to secure their preservation in the most effectual manner, and to prevent any injudicious or indiscreet use of them, to the risk of which they might otherwise have been exposed.

In discharging the duty imposed on the Society by their acceptance of this bequest, there can be no doubt that the whole of the documents thus acquired must be carefully and faithfully preserved. It may be true that in the general mass there are some articles apparently of little value, which may have owed their preservation to accident or oversight ; but your Committee can by no means encourage the idea, that in attempting to separate these from what they might deem truly valuable, the Society would be safe in exercising any discretion whatever ; for, most assuredly, however judicious the selection might be, it would not fail to expose them hereafter to misrepresentation and reproach.

On the more difficult question as to the disposal of these manuscripts, the Committee have not arrived at any clear or decided opinion. Thus far, indeed, they conceive it to be evident, in the first place, that the property must remain inalienably in the Society, and that to convert it into a subject of pecuniary speculation would be an abuse of the confidence reposed in them by the testator ; and in the second place, that to undertake directly, and in their own name, the publication of the whole or of any portion of these manuscripts, would not be in accordance with the proper character and functions of that learned Body. If in these respects the views entertained by the Committee shall be deemed correct, the only obvious alternative seems to be, to await the opportunity of entrusting the use of these manuscripts to an Editor, who may in all respects be thought worthy of the confidence of the Society, and who may intend to employ them either as the Illustrations of a Life of Mr Hume, or as a separate publication of his Private and Confidential Correspondence. There appears to your Committee to be no good reason for any hurry or impatience in accomplishing such an arrangement ; and, in the mean time, it is obviously proper that these papers should be accessible to the inspection of such persons, Members of the Society or others, as may apply to the Council of the Society for that purpose ; all due precautions being taken against any abuse of the liberty so to be conceded.

Having said so much on what the Committee regard as the more

important portion of the Hume Papers, it remains to take notice, in a few words, of the other parts of this bequest. Among these there is what may be regarded as in the nature of a Common-place Book, written evidently at an early period, which would be found to furnish some useful hints to a biographer in tracing the progress of Mr Hume's studies, and the formation of his opinions. Besides these, and a few other miscellaneous papers of no great importance, there are the original manuscripts of the earlier part of the History of England, of the Dialogues on Natural Religion, and of his own Life. Of these, the chief value is derived from the highly instructive exhibition they afford of the infinite care and pains with which Mr Hume revised and corrected all his compositions, and by means of which he succeeded in giving to his style not only its minute accuracy, but much also of its characteristical force and spirit. The successive editions of his works are well known to afford abundant evidence of his uncommon anxiety and care in these respects, and their collation has been found to furnish most useful lessons to the students of English style; but in these manuscripts the process of revisal and correction becomes still more apparent and remarkable, and renders them of considerable curiosity.

THO. THOMSON.
JOHN ABERCROMBIE, M.D.
ALEX. MACONCHIE.
JAMES PILLANS.
JOHN SINCLAIR.

The following postscript has since been added by order of the Council:—

POSTSCRIPT.

It may be proper to add to the statements in the preceding Report, that among the original letters comprehended in Baron Hume's bequest, there are a few that have already been printed. Of these, the most important are some of the letters relative to Mr Hume's ill-fated connection with M. Rousseau, published either at the time by himself and others, or in a volume entitled his Private Correspondence, printed at London in 1820. The only others here deserving of particular notice are a few of the letters written by Mr Hume near the close of his life, and communicated by Baron Hume to the editor of the Literary Gazette, and published in London in the year 1821. It is scarcely necessary to add, that there still exist many other

valuable letters of Mr Hume, the originals of which had not come into the possession of his executors, and that a considerable number of these have appeared in various biographical and periodical publications.

2. On the Optical Properties of Greenockite, by Sir David Brewster, in a letter to Lord Greenock.

Greenockite has the form of a regular six-sided prism, with pyramidal summits, the faces of the pyramid being inclined $36^{\circ} 20'$ to their base. The pyramids are sometimes truncated on their summit.

The crystallization is often composite.

The index of refraction of Greenockite is 2.6882, corresponding to the middle of the green space, and to the ordinary ray. Hence Greenockite exceeds the *Diamond* in refractive power, and also *chromate of lead*, which I had found to surpass the diamond in this respect.

The double refraction of Greenockite is comparatively small, which is not usual in substances of a high refractive power. It is so small, indeed, that owing to its great dispersive power it is exceedingly difficult to separate the two images.

The polarising angle of Greenockite is $68^{\circ} 36'$ for the *red* rays, which corresponds to an index of refraction for that light of 2.5517.

I found it very difficult to establish the existence of an *uniaxal* system of rays along the axis of the prism; but I succeeded in doing this by light of the condensed rays of the sun, by which it can alone be established; for when in biaxal crystals one of the axes is very weak, as in nitre, its influence on the rays is scarcely visible in crystals of little thickness, such as those we meet with in Greenockite.

The uniaxal system of rings is *negative*, as in calcareous spar. The light left at the polarising angle is blue and pink.

Professor Forbes, after reading the foregoing communication, remarked that the uniaxal structure of Greenockite was ascertained by himself with the aid of concentrated gas-light, and that his notice on the subject was published in the *Philosophical Magazine* for July 1840.

3. On the Results of the most recent Experiments on the Conducting Power for Heat of different Soils. By Professor Forbes.

The author gave, in continuation of a former paper (see Proceedings of the Royal Society of Edinburgh, 3d Dec. 1838), an account of the continued systematic prosecution and annual reduction of the observations of temperature at different depths (3, 6, 12, and 24 French feet) below the surface of the ground, in various geological formations near Edinburgh, viz. the trap rock of the Calton Hill, the incoherent sand of the Experimental Garden, and the coal formation sandstone of Craigleith Quarry. The weekly observations at all these stations have been projected into curves, which present the most remarkable concordance of general features for the four years now complete, and give a just confidence in the comparability of the results obtained. The thermometric readings have all been rigorously corrected for the expansion of the alcohol in the tubes; and, starting from these data, the results in the following tables have been obtained, partly by graphical methods, partly by calculation. The quantity marked A is the log. range at the surface. The quantity B (which is the most interesting result) marks the rate of diminution of the range as we descend, and is proportional to the square root of the specific heat of the soil divided by its conducting power. M. Regnault of Paris has kindly undertaken to determine the specific heats by direct experiment, whence the conductivity will become known; and the comparison of the results for four years proves that we have already obtained a near approximation to its value, which is well defined for the different formations, but especially for the Sandstone, when contrasted with the other two. The results of Tables III. IV. and V. are deduced from the numbers in Table I.; and for the sake of comparability with the foreign observations, the French foot and centigrade degree have been employed as units. So well do the observations of the different thermometers for any one station accord together, that, taking any two of the thermometers and combining their results by pairs, we should obtain nearly the same conclusions. These conclusions are also in accordance with those which the Epochs in Table II., and the rate of Progress of Heat downwards in Table VI., present; the best conducting soil (that for which B has the smallest numerical value) transmitting the heat fastest.

TABLE I.—RANGE IN CENTIGRADE DEGREES.

| | 3 FEET. | | | 6 FEET. | | | 12 FEET. | | | 24 FEET. | | |
|------|---------|-------|---------|---------|-------|---------|----------|-------|---------|----------|-------|---------|
| | Trap. | Sand. | Sandst. | Trap. | Sand. | Sandst. | Trap. | Sand. | Sandst. | Trap. | Sand. | Sandst. |
| 1837 | 10.53 | 11.23 | 9.58 | 6.61 | 8.30 | 7.72 | 3.05 | 4.19 | 5.22 | 0.80 | 1.16 | 2.28 |
| 1838 | 9.83 | 11.30 | 10.29 | 6.22 | 8.10 | 7.91 | 2.80 | 3.94 | 5.16 | 0.70 | 1.0 | 2.13 |
| 1839 | 8.64 | 10.55 | 9.14 | 5.73 | 7.76 | 7.40 | 2.69 | 3.95 | 4.64 | 0.76 | 0.79 | 2.20 |
| 1840 | 8.29 | 10.14 | 18.98 | 5.70 | 7.35 | 7.28 | 2.50 | 3.72 | 4.63 | 0.89 | 1.06 | 2.07 |

TABLE II.—EPOCHS OF MINIMA.

| | EPOCHS OF MAXIMA. | | | | | | | | | | | |
|------|-------------------|---------|---------|---------|---------|---------|---------|----------|----------|---------|---------|---------|
| | 1837 | 1838 | 1839 | 1840 | 1837 | 1838 | 1839 | 1840 | 1837 | 1838 | 1839 | 1840 |
| 1838 | Feb. 26 | Mar. 3 | Feb. 23 | Mar. 14 | Mar. 19 | Mar. 3 | Apr. 20 | Apr. 22 | Mar. 20 | July 18 | July 8 | May 12 |
| 1839 | Mar. 14 | Feb. 24 | Feb. 24 | Mar. 27 | Mar. 25 | Mar. 4 | Apr. 30 | Apr. 22 | Apr. 1 | July 12 | June 24 | May 12 |
| 1840 | Mar. 1 | Feb. 25 | Mar. 1 | Mar. 14 | Mar. 15 | Mar. 8 | Apr. 19 | Apr. 18 | Mar. 21 | July 5 | June 26 | Apr. 30 |
| 1837 | Aug. 6 | July 31 | Aug. 5 | Sept. 2 | Aug. 24 | Aug. 19 | Oct. 17 | Oct. 6 | Sept. 11 | Jan. 8 | Dec. 30 | Nov. 11 |
| 1838 | Aug. 8 | Aug. 6 | Aug. 16 | Sept. 6 | Aug. 31 | Aug. 23 | Oct. 19 | Oct. 14 | Sept. 19 | Jan. 5 | Jan. 4 | Nov. 2 |
| 1839 | Aug. 1 | July 30 | July 30 | Aug. 26 | Aug. 19 | Aug. 14 | Oct. 10 | Oct. 3 | Sept. 11 | Jan. 8 | Dec. 26 | Nov. 4 |
| 1840 | Aug. 23 | Aug. 18 | Aug. 18 | Sept. 4 | Sept. 2 | Aug. 23 | Oct. 6 | Sept. 30 | Sept. 9 | Jan. 3 | Dec. 18 | Oct. 26 |

TABLE III.—VALUES OF A.

| | Trap. | Sand. | Sandstone. |
|------|-------|-------|------------|
| 1837 | 1.164 | 1.176 | 1.076 |
| 1838 | 1.173 | 1.217 | 1.114 |
| 1839 | 1.086 | 1.182 | 1.049 |
| 1840 | 1.073 | 1.155 | 1.044 |

TABLE IV.—VALUES OF B.

| | | | |
|------|--------|--------|--------|
| 1837 | —0.545 | —0.440 | —0.316 |
| 1838 | —0.641 | —0.517 | —0.345 |
| 1839 | —0.516 | —0.498 | —0.305 |
| 1840 | —0.550 | —0.470 | —0.308 |

TABLE V.—ANNUAL RANGE REDUCED TO 0.01 CENT.

| | | | |
|------|---------------|---------------|---------------|
| 1837 | 58.1 F. Feet. | 72.2 F. Feet. | 97.3 F. Feet. |
| 1838 | 49.3 | 61.8 | 91. |
| 1839 | 59.2 | 63.5 | 100. |
| 1840 | 55.9 | 67.1 | 98.8 |

TABLE VI.—VELOCITY OF PROPAGATION OF HEAT DOWNWARDS.

MAXIMA.

| | Trap. | Sand. | Sandstone. |
|------|-----------|-----------|------------|
| 1837 | 7.5 days. | 7.1 days. | 4.9 days. |
| 1838 | 6.8 | 6.8 | 3.6 |
| 1839 | 7.8 | 7.2 | 4.6 |
| 1840 | 6.6 | 5.95 | 3.5 |

MINIMA.

| | Trap. | Sand. | Sandstone. |
|------|-----------|-----------|------------|
| 1838 | 6.5 days. | 5.8 days. | 3.6 days. |
| 1839 | 6.0 | 5.1 | 3.6 |
| 1840 | 6.1 | 5.7 | 3.05 |

James Thomson, Esq., Civil Engineer, proposed by Dr Thomas Thomson of Glasgow, was duly elected an Ordinary Fellow of the Society.

The following Donations were presented to the Society since last Meeting :—

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiii. Nos. 19, 20, 21.—*By the Academy.*

Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen, door de Leden der Natuurkundige Commissie in Oost Indie en Andere Schrijvers. Afleverings 1, 2, 3.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiv.—*By the Academy.*

Mémoires couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xv. Ptie. 1.—*By the Academy.*

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte in Königsberg. Von F. W. Bessel. 20te Abtheilung.—*By the Author.*

Proceedings of the Royal Society. No. 49.

Catalogue of Miscellaneous Literature in the Library of the Royal Society. 8vo.—*By the Society.*

An Account of the Vegetation of the Outer Hebrides. By J. H. Balfour, M.D., F.R.S.E.—*By the Author.*

Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London. Vols. 4, 5. 4to.—*By the Royal College of Surgeons.*

Monday, 3d January 1842.

Dr HOPE, V.P. in the Chair.

The following communications were read :—

1. On the Cultivation of the Sugar-Cane in Spain. By Dr Traill.

He prefaced it by a short sketch of the knowledge which the ancients had of this plant, of its introduction into Europe, and from thence into the American Islands. He endeavoured to shew, from Spanish authorities, that very soon after the discovery of America, the Spaniards carried the sugar-cane, among other useful plants, with them to the West Indies, and sedulously

cultivated it; and he considered the speculations of *Labat* and *Laftau*, on the supposed American origin of the cane, as very inconclusive.

The author's remarks on the Spanish cultivation of the cane were the results of his personal observations during a residence of some months in Spain in the year 1814, and of some statistical information afforded to him by the late Wm. Kirkpatrick, Esq. of Malaga. The sugar-cane culture was introduced by the Moors, soon after their conquest of Spain, and flourished exceedingly even after the overthrow of their empire in the Peninsula. Its first serious check was from the cruel and impolitic expulsion of the Moriscoes in 1609; its second, from the enormous extension of sugar plantations in the West Indies and South America. Yet, notwithstanding the capricious oppressions of a tyrannical government, it has subsisted to the present time as a considerable branch of Spanish agriculture, with periodic fluctuations in its prosperity, for two hundred years since the expulsion of the most industrious inhabitants of Spain.

He described the district producing sugar, at the period of his visit, as extending along the shores of the Mediterranean, from *Adra* to *Manilba*, a distance of 130 miles. The breadth of this track, however, is small—not more, on an average, than four or five miles, being hemmed in on the west and north by the rugged mountains of Andalusia. These ranges screen it from the west and north winds; but as the most lofty are crowned with perennial snow, occasional frosts are injurious to the sugar planter. The general climate of Andalusia was shewn by Dr T. to be remarkably mild throughout the year; as is proved by the luxuriant growth of *Chamærops humilis*, *Cactus Opuntia*, *Agave Americana*, the orange and the lemon, and the date-palm, in Southern Andalusia.

Along the track in question there are many sugar plantations, and a considerable number of sugar-mills, moved either by water or by mules. Most of the plantations are small; but one estate made 4600 loaves of white sugar annually, each of the value of ten dollars. Most of the Spanish sugar, however, was either *Muscovado* or *clayed* sugar. The statistical remarks shewed that a well-managed estate, near Marbella, returned in the worst years 7 per cent. on the capital employed, in middling years 11 per cent., and in good years from 16 to 20 per cent., after deducting all charges.

2. On the Theory of the Parallel Roads in the Glens of Lochaber. By Sir G. S. Mackenzie, Bart.

Sir George Mackenzie read a paper on the Theory of the Parallel Shelves in the Glens of Lochaber, in which he first noticed the objections to the theories that ascribed the origin of these appearances to fresh-water lakes, the barriers of which had been destroyed at different periods; and to the ordinary action of the sea when the land was at a lower level than at present. The causes supposed to have removed the barriers, in the first case, being violent disruptions, the preservation of level and parallelism is totally inconsistent with such operations. In the second case, the shelves being confined to the single locality of these glens, while, supposing them to have been sea-beaches, the appearances of such shelves should be frequent and to be seen every where; it becomes necessary that the elevation of the land should have been confined to a narrow locality, and to have exhibited a boundary no where to be found. In this case, also, the elevation of the land must have been sudden, otherwise the traces of the action of the sea would have been seen continuous all over the sides of the glens. Sudden elevation being therefore necessary, it is not at all probable that the levels and parallelism could have been preserved so perfectly as to be in accordance with the curvature of the earth.

Sir George alluded to the researches of Sir James Hall in reference to the debacle or flood that appears to have passed over the country; and to the notions of Professor Agassiz, that ice, a universal glacier, had produced the phenomena which had been attributed to the debacle. He denied that these phenomena could have been the effects of glaciers properly so called; though, as stated by him in a paper read last session, masses of ice may have been, and most probably were, brought from the Arctic Regions by the debacle, and may have been arrested in the narrow passes among the mountains, forming temporary glaciers, if such an appellation may be applied to them, and producing effects not easily accounted for without such assistance. Sir George then pointed out a singularity in the localities of the Lochaber glens, in reference to the demonstrated course of the debacle, which had led him to attribute to that catastrophe the formation of the shelves. The openings of the glens face that course, and they turn towards the north, so as to become nearly parallel to the Great Glen. The highest summit level is between Glen Gluoy and Glen Roy, and the other lower summit levels are between Glen Roy, Glen Spean,

and the valley of the Spey. The debacle coming from the NW. would fill these glens, and flow over the summit levels. As soon as it subsided below that of Glen Gluoy, that glen would be in the condition of a lake or arm of the sea, and defended from the great tumult of waters by the mountain ridge betwixt it and the Great Glen, while the agitation would be sufficient quickly to produce the highest of the shelves. When the waters subsided below the summit level of Glen Roy, then the highest shelf in that glen would begin to be formed. As the subsidences would be irregular, in consequence of the agitation of the waters, and the influence of the varied surface of the land, and as also the tides would contribute in a considerable degree to this irregularity, Sir George conceived a sudden subsidence, and a sudden stoppage for a time, amply sufficient for the formation of the imperfect terraces or shelves, the sections of which clearly indicate something very different from the comparatively tranquil operations of the sea on the coast. The lowest shelf appears to have formed on the subsidence of the water below the summit level betwixt Glen Spean and the valley of the Spey. The shelves disappear at the points where the agitation of the waters may be supposed to have been too great for their formation, on account of vicinity to the Great Glen; and, consequently, we may expect the diluvium to assume the appearance in that locality which it exhibits in many others, and modified by the shape of the surface. This modification is beautifully exhibited whenever the effects of the land on the movement of the waters is taken into account, and which it has never been sufficiently, when the theory of a debacle has been discussed.

Sir George admitted fully the probability that masses of ice, brought by the debacle, may have rested at the openings of these glens, and acted as barriers to a certain extent; but this, he considered, does not affect his general theory, while it rather strengthens it. The erratic blocks found on the shelves may have been deposited by ice; and if rounded pebbles, brought in evidence by Mr Darwin against Sir George's theory, could not have been produced by such a vast torrent, the great abundance of ready-made pebbles to be found in the masses of conglomerate over which the flood had to pass, would sufficiently remove the objection. Sir George expressed himself as by no means anxious about the fate of his theory, because a philosophical examination of it, if condemnatory, would remove obstacles in the way of arriving at truth; and if laudatory, would lead to a correct explanation of facts still in a somewhat anomalous state.

3. On the Results obtained with different forms of Rain-Gauges. By Joseph Atkinson, Esq. Communicated by David Milne, Esq.

The objects proposed were—

First, To discover the difference, which the *height* of Rain-Gauges above the surface makes in the amount of rain received by each gauge.

Second, To try the effect of an *Inclined Funnel*, which always presents itself towards the wind.

Third, To test the action of a *Globular Gauge* or Sphere.

Fourth, To investigate whether any and what difference the *size* of the funnel made in the quantity of rain received.

The number of gauges used to accomplish these objects was six;—of which three were horizontal funnels, 12 inches in diameter, placed respectively 0, 3, and 6 feet above the surface; one was a copper sphere, 36 inches in circumference, placed 6 feet above the surface; one was a funnel, 12 inches in diameter, placed at an angle of about 45 degrees, and 6 feet above the surface—a vane was attached to the rim of this funnel, and this last moved upon a pivot over the receiver; and the sixth gauge had a funnel of 18 inches diameter, placed horizontally, and six feet above the surface.

The results obtained from these gauges in twelve months, beginning with November 1840, were as follows:—

First, The excess of the surface gauge over that which was three feet above the ground, was nearly identical with the excess of the latter over that which was six feet above; the excess in the first mentioned case being 1.816 inches—in the latter, 1.865 inches.

Second, The inclined and moveable funnel always took more rain than the horizontal funnel on the same level during strong winds, and less during calm winds. The difference between these two gauges was, in twelve months, only 1.887 inches. In that period, the horizontal funnel on the surface had taken 1.804 inches more rain than the inclined funnel, the latter being placed 6 feet above the surface.

Third, The globular gauge, instead of receiving more rain than the common horizontal funnel at the same level, as might have been expected, received 0.560 inches less in the twelve months. In the first six months, it received more rain than the horizontal funnel, but during the warm months it received considerably less. During the cool months it represented very fairly the mean of the

horizontal funnel and the inclined funnel; but during the summer months it failed in doing so, that failure being greatest in August, when it had taken 0.536 inches less than the mean of the other two gauges. In the twelve months the globular gauge had taken 1.503 inches less than the mean of the other two gauges.

Fourth, The funnel, which had a diameter of 18 inches, received 2.505 inches less rain than a funnel 12 inches in diameter, which was placed at the same height. And this difference was not the effect of one or two months; for it will be observed, on reference to the Table, that the quantity received by the larger funnel was uniformly less than the quantity received by the smaller.

These results were obtained at Harraby, near Carlisle.

NUMERICAL RESULTS—SUMMARY.

| 1840-1. | 12-inch Funnel on the Surface. | 12-inch Funnel 3 feet above Surface. | 12-inch Funnel, horizontal, 6 feet above Surface. | 12-inch Fun- nel at an angle, and with Vane, 6 feet above Surface. | Sphere, 36 inches in circumfer- ence, 6 feet above Surface. | 18-inch Funnel, horizontal, 6 feet above Surface. |
|---------|---|--|--|---|--|--|
| | 1. | 2. | 3. | 4. | 5. | 6. |
| Nov. | 3.089 | 3.112 | 2.709 | 3.158 | 2.877 | 2.709 |
| Dec. | 0.439 | 0.429 | 0.369 | 0.393 | 0.405 | 0.291 |
| Jan. | 3.182 | 2.594 | 2.364 | 2.668 | 2.560 | 2.129 |
| Feb. | 1.569 | 1.477 | 1.249 | 1.681 | 1.337 | 1.167 |
| March. | 2.728 | 2.571 | 2.407 | 3.550 | 3.042 | 2.153 |
| April. | 2.587 | 2.576 | 2.429 | 2.915 | 2.481 | 2.324 |
| May. | 2.406 | 2.261 | 2.172 | 2.435 | 2.181 | 2.074 |
| June. | 3.380 | 3.405 | 3.243 | 3.193 | 2.882 | 3.013 |
| July. | 3.270 | 3.180 | 3.166 | 2.666 | 2.717 | 2.902 |
| Aug. | 6.597 | 6.456 | 6.210 | 5.651 | 5.394 | 5.780 |
| Sept. | 3.941 | 3.901 | 3.863 | 3.405 | 3.507 | 3.377 |
| Oct. | 6.035 | 5.444 | 5.360 | 5.713 | 5.598 | 5.117 |
| | 39.222 | 37.406 | 35.541 | 37.428 | 34.981 | 33.036 |

The sum of the Sphere (5.) less than the mean of the Horizontal and Vane (3. and 4.) by 1.503.

The sum of the Surface (1.) more than the sum of the Vane (4.) by 1.804.

The sum of the 18-inch Funnel (6.) less than the sum of the 12-inch Funnel (3.) by 2.505.

The following Donations were presented to the Society since the last meeting :—

Mémoires de l'Académie Imperiale des Sciences de Saint Petersbourg. (Sciences Mathématiques et Physiques.) Tome ii. Liv^{ns} 5, 6.

Do. do. (Sciences Naturelles.) Tome iii. Liv^{ns} 5, 6, et Tome iv. Liv^{ns} 1, 5.

Do. do. (Sciences Politiques, Histoire, Philologie.) Tome v. Liv^{ns} 1, 4.

Do. do. (Par divers Savans, et lus dans ses Assemblées.) Tome iv. Liv^{ns} 3, 4.

Recueil des Actes de la Séance Publique de l'Académie Impériale des Sciences de Saint-Petersbourg, tenue le 29 Dec. 1840.—*By the Imperial Academy.*

Bullétin de la Société Imperiale des Naturalistes de Moscow, 1840. Nos. 1, 4, et 1841. No. 1.—*By the Society.*

Ueber den Galvanismus als chemisches Heilmittel gegen örtliche Krankheiten, von Dr Gustav Crusell.—*By the Author.*

